Application No. 10/064,757
Attorney Docket No. 125691-3 (13591US03)

REMARKS

The present application includes claims 1-29. Claims 1-29 were rejected. By this Amendment claims 1, 4-10, 12, 19, 23-25, and 27 have been amended. By this Amendment, claims 30-35 have been added.

Claims 30-35 have been added. These claims are dependent, and add limitations to independent claim1. Claims 30-35 recite a variety of different independently configurable trigger event types. These limitations are not taught by the prior art, and consequently, claims 30-35 are respectfully submitted as allowable.

Claims 12-18 were rejected under 35 U.S.C. §102(b) as being anticipated by Boyd et al., U.S. Patent No. 4,352,021.

Claims 1-3, 5, 6, 8, and 11 were rejected under 35 U.S.C. §103(a) as being unpatentable over Slack et al., U.S. Patent No. 6,393,091.

Claims 4, 7, 9, and 10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Slack et al., U.S. Patent No. 6,393,091, in view of Mao et al., U.S. Patent No. 6,708,052.

Claims 19-29 were rejected under 35 U.S.C. §103(a) as being unpatentable over Richey et al., U.S. Patent No. 4,547,892, in view of Boyd et al., U.S. Patent No. 4,736,396.

The Applicant now turns to the rejection of claims 12-18 under 35 U.S.C. §102(b) as being anticipated by Boyd et al., U.S. Patent No. 4,352,021. Boyd '021 discusses a mode of triggering CT scans for the particular application of determining regional

myocardial perfusion and blood flow in coronary arteries and cavities starting at Col. 5, Line 54. In this mode, as described from Col. 5, Lines 59-62 of Boyd '021, triggering of a CT scan can be based on a physiological signal as represented by an electrocardiogram. Boyd '021 also mentions a technique in this mode at Col. 5, Lines 64-67 of skipping one heartbeat between scans in order to allow the computer one full second for each sequence. In addition, Boyd '021 discusses at Col. 5, Line 41-47 using a moveable gurney in order to vary the patient's body respect to the scanner axis. As further mentioned, the purpose of the moveable gurney is to image cardiac cross-sections which are transverse to the long and short axes of the heart.

Boyd '021 does not, however, teach a beam control system which is capable of generating a trigger sequence. Boyd '021 discusses selecting a trigger point, not a trigger sequence. For instance, Boyd '021 discusses triggering from a physiological signal from the heart at Col. 5, Lines 59-62, and based on an appropriate physiological signal at Col. 6, Lines 32-33. A trigger point based on a physiological signal is not a trigger sequence.

Moreover, Boyd '021 does not teach a beam control system capable of generating a trigger sequence with independently configurable trigger events. Contrarily, the Boyd '021 method requires that a trigger point must always be the same for a given set of scans. As described in Boyd '021 starting at Col. 5, Line 68, "The exact phase of the cardiac cycle selected for scanning is not critical as long as the timing is repeatable from beat to beat." Thus, Boyd '021 does not teach a beam control system capable of generating independently configurable trigger events.

Additionally, Boyd '021 does not teach a moveable patient positioner for automatically positioning a patient between a target ring and a detector ring. Rather, Boyd '021 mentions a moveable gurney only for adjusting the patient before a set of scans is performed. As it appears, Boyd '021 provides a moveable gurney simply to make the patient more comfortable and to reduce patient motion when scanning sections transverse to the long and short axes of the heart.

Conversely, amended claim 12 recites a beam control system capable of generating a trigger sequence with independently configurable events, and a moveable patient positioner for automatically positioning a patient. Because Boyd '021 does not teach a trigger sequence with independently configurable events, and because Boyd '021 does not teach a moveable patient positioner for automatically positioning a patient, Boyd '021 does not teach the limitations of claim 12.

Consequently, independent claim 12 is respectfully submitted as allowable. Claims 13-18 depend from independent claim 12, and therefore are also respectfully submitted as allowable.

The Applicant now turns to the rejection of claims 1-3, 5, 6, 8, and 11 under 35 U.S.C. §103(a) as being unpatentable over Slack et al., U.S. Patent No. 6,393,091 Slack discusses a technique for non-uniform sampling of the cardiac phase. Slack's technique is described generally from Col. 2, Line 60 through Col. 4, Line 18. This technique involves observing a patient's cardiac cycle, and then assigning a priority value to a number of potential sampling points along the patient's cardiac cycle. Then, as discussed

at Col. 4, Lines 15-18, "a number of points N of highest priority are selected, where N is a number of phases desired for generating images." As further described at Col.4, Lines 19-39, once these sampling points are selected, Slack's technique repetitively uses the same selected sampling points. As mentioned at Col. 2, Lines 40-43, sampling is then performed by the data acquisition system which samples analog data from x-ray detector elements.

Slack does not teach or suggest scanning the patient beginning at a triggering sequence. Indeed, Slack does not teach triggering at all. The word "trigger" cannot be found in the Slack reference. Rather, Slack discusses a data acquisition system that samples analog data from x-ray detector elements. Slack also mentions providing a reference phase for CT scans. However, sampling analog data at a data acquisition system, and providing a reference phase for scanning times is not the same as scanning based on a triggering sequence. Thus Slack does not teach or suggest scanning based on a triggering sequence at all.

Nor does Slack teach or suggest selecting trigger sequences that each have events independently configurable with respect to a patient. Slack's sampling points are not independently configurable, because Slack's technique requires that the same set of selected sampling points are reused without change for every subsequent scan (for a given set of scans).

Conversely, amended claim 1 recites selecting independently configurable triggering sequences, each sequence capable of associating two or more events, where

each event is capable of being independently configurable based on an occurrence within one cardiac cycle, an occurrence of a single cardiac cycle, an occurrence of a plurality of cardiac cycles, or an occurrence not based on a cardiac cycle. Slack does not teach or suggest these limitations. Consequently, claim 1 is respectfully submitted as allowable. Claims 2, 3, 5, 6, 8, and 11 depend from independent claim 12, and therefore are also respectfully submitted as allowable.

The Applicant now turns to the rejection of claims 4, 7, 9, and 10 under 35 U.S.C. §103(a) as being unpatentable over Slack et al., U.S. Patent No. 6,393,091, in view of Mao et al., U.S. Patent No. 6,708,052. Mao, starting at Col. 4, Line 6, discusses a method of basing a trigger point on the length of a cardiac cycle. As seen in FIG. 2 and starting at Col. 2, Line 59, Mao's scheme involves four steps: measuring an average R-R cardiac length (i.e. average heart rate); calculating the R-T segment length based on gender and the R-R interval length; identifying the optimal scan point based on a static set of rules (see Table 1 at Col. 6, Lines 25-45); and triggering the scan based on the optimal scan starting point. As further described at Col. 6, Lines 57-61, the optimal scan starting point may vary dynamically based on the average cardiac cycle length.

Mao does not teach or suggest the selection of trigger sequences. By contrast, Mao describes, for example at Col. 6, Lines 57-59, triggering based on an optimal scan starting point. A trigger point is not a trigger sequence.

Nor does Mao teach or suggest an independently configurable trigger sequences. While Mao does mention dynamically varying a trigger point from scan to scan, there is

no way under Mao's scheme to independently configure triggers. A dynamically varying trigger point is not an independently configured trigger sequence.

Conversely, amended claim 1 recites selecting independently configurable triggering sequences. Mao does not teach or suggest this limitation. Consequently, claim 1 is respectfully submitted as allowable. Claims 4, 7, 9, and 10 depend from independent claim 1, and therefore are also respectfully submitted as allowable.

The Applicant now turns to the rejection of claims 19-29 under 35 U.S.C. §103(a) as being unpatentable over Richey et al., U.S. Patent No. 4,547,892, in view of Boyd et al., U.S. Patent No. 4,736,396.

Regarding claims 19-26, Richey discusses at Col. 3, Lines 18-20, providing a trigger by feeding the output of a QRS detector through a delay circuit. As mentioned at Col. 3, Lines 38-44, the delay circuit is adjusted based in part on a predication of when a particular cardiac phase of interest will occur in the patient's average cardiac cycle. As further discussed at Col. 3, Lines 60-61, "The ultimate objective is to synchronize the CT cardiac scanning with cardiac contractility."

Richey does not, however, teach or suggest the use of at least two independently configurable trigger sequences. Rather, Richey discusses using a single specific apparatus to trigger a CT scanner. As discussed above, this apparatus consists of feeding the output of a QRS detector into delay circuit. This apparatus has a predictable output, once determined. The use of a single apparatus with a predictable output for triggering is not the same as the use of two independently configurable trigger sequences.

As discussed starting at Col. 4, Line 16, Richey discusses only a need to have predictable timing from scan to scan. Reading further at Col 4, Lines 22-29, Richey discusses discarding a scan if an observed cardiac cycle exceeds tolerance standards. Therefore, Richey maintains an initially provided trigger, and discards scans if the patient's cardiac cycle appears irregular. In other words, Richey does not independently configure trigger sequences on the front end, but rather selectively discards unhelpful scans on the back end. Thus Richey does not teach or suggest use of at least two independently configurable trigger sequences.

Boyd '396 mentions, at Col. 3, Lines 62-65, scanning a patient at a variety of couch positions. Reading further at Col. 4, Lines 3-10, this involves scanning a patient at a given couch position, generating a one-dimensional tomographic image, moving the patient, generating subsequent one-dimensional images, and constructing a two-dimensional image from one-dimensional images.

Boyd '396 does not teach or suggest the generation of cine images. Boyd '396 does not even mention cine imaging. Rather, Boyd '396 discusses generating static two-dimensional images from a series of one-dimensional images. Thus, Boyd '396 does not teach or suggest moving the patient to generate cine images.

Nor does Boyd '396 teach or suggest the use of at least two independently configurable trigger sequences. Boyd '396 does not mention triggering or gating.

Nor does Boyd '396 teach or suggest coordinating the motion of a patient with the scanning of the patient with at least two independently configurable trigger sequences.

Rather, Boyd '396 talks only about having more than one patient couch position. No specific technique is provided by Boyd '396 to coordinate scanning and couch movement.

Conversely, amended claim 19 recites coordinating sweeping the energy beam and moving the patient with at least two independently configurable trigger sequences, and also generating cine loops. Neither Richey nor Boyd '396 teach or suggest these limitations. Consequently, claim 19 is respectfully submitted as allowable. Claims 20-26 depend from claim 19, and are therefore also respectfully submitted as allowable.

Regarding claims 27-29, Richey describes an apparatus, at Col. 4, Lines 30-54, designed to reject a scan when the patient's heartbeat does not behave as predicted. Driving the output of this circuit is a binary comparator. This comparator sends a flag to the image processing unit if the particular scan is to be discarded.

Richey does not teach or suggest associating additional cardiac information with the digital image signals. Rather, under Richey's scheme, scans are merely deleted when the beat was not as predicted. There is no association of a patient's cardiac information on the image acquisition side.

Nor does Richey teach or suggest generating a cine sequence from image data signals and associated additional cardiac information. As pointed out, Richey's scheme does not associate a patient's cardiac information with the image data. Rather, it deletes scans based on predetermined thresholds of acceptable patient heart rate. Richey's image processor is just left with raw scan data, some of which has been deleted. Richey does

not, therefore, teach or suggest generating a cine sequence from image data and associated additional cardiac information.

Conversely, amended claim 27 recites associating additional cardiac information indicative of the patient with image data signals, and generating a cine sequence of cardiac images from image data signals and associated additional cardiac information. Neither Boyd '396 nor Richey teach or suggest these limitations. Consequently, claim 27 is respectfully submitted as allowable. Claims 28-29 depend from claim 27, and are therefore also consequently submitted as allowable.

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CONCLUSION

If the Examiner has any questions or the Applicant can be of any assistance, the Examiner is invited and encouraged to contact the Applicant at the number below.

The Commissioner is authorized to charge any necessary fees or credit any overpayment to the Deposit Account of GTC, Account No. 070845.

Respectfully submitted,

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